

NCST Investigation of the Champlain Towers South Collapse

Cross-Project Panel Theme 2: Materials, Geotechnical, and Structural Analysis and Testing

Glenn Bell, Kenneth Hover, Scott Jones, Youssef Hashash, and Fahim Sadek

CTS Investigation: Structural Code Checks

NIST

Original codes: SFBC* 79 / ACI^ 318-77

Current codes: ASCE† 7-22 / ACI 318-19

*South Florida Building Code

^American Concrete Institute

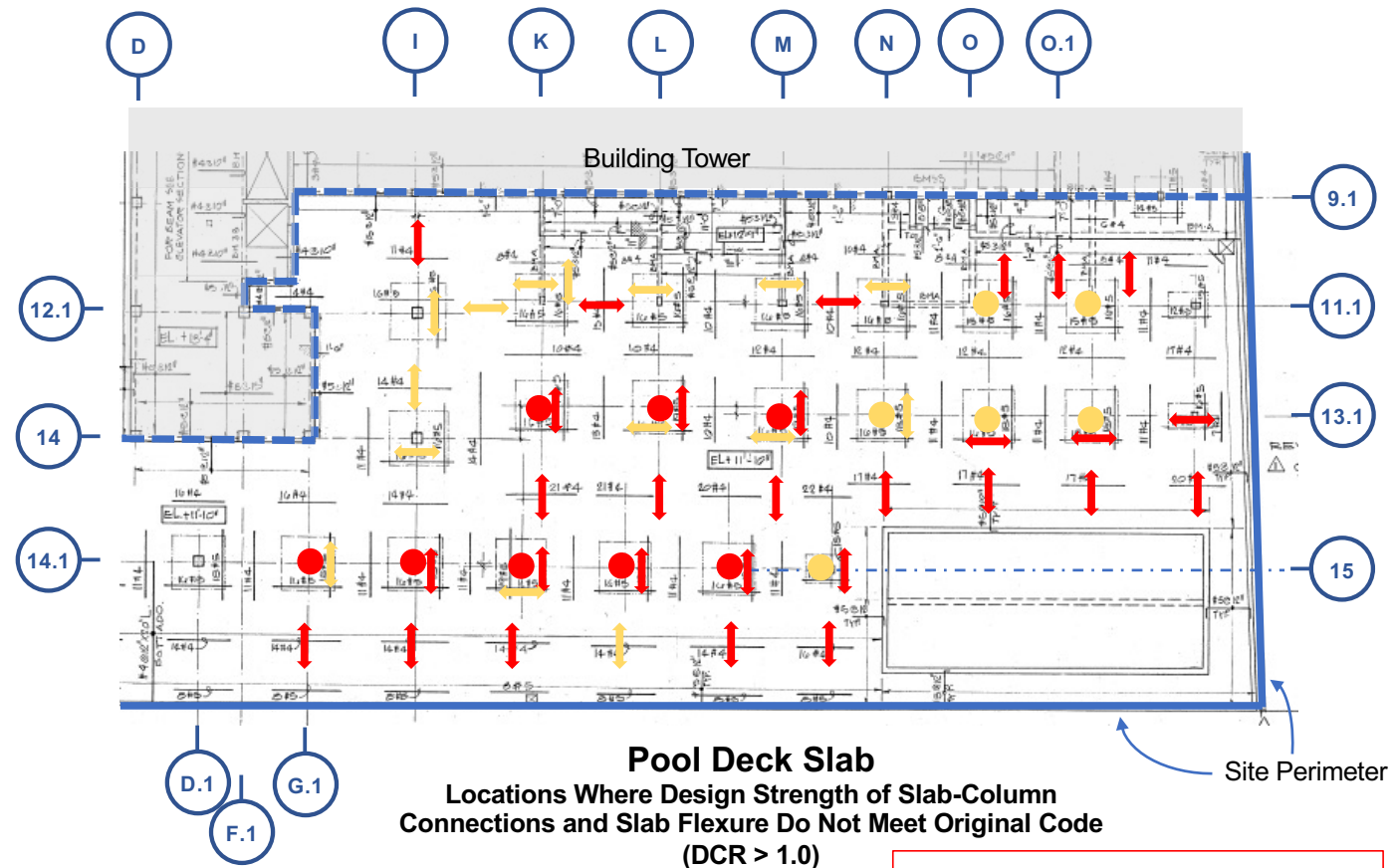
†American Society of Civil Engineers

Key Preliminary Observations:

- Pool Deck: design strength does not comply with the original codes and standards, with many areas of severe strength deficiency.
- Tower: work in progress.

Figure Legend

| Degree of Understrength | Location of Understrength | |
|-------------------------|---------------------------|--------------|
| | slab-column connections | slab flexure |
| severe | ● | ↔ |
| moderate | ● | ↔ |



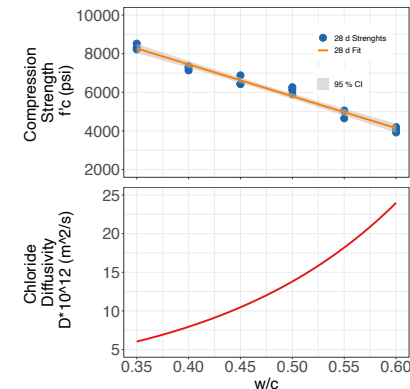
PRELIMINARY ANALYSIS RESULTS

CTS Investigation: Concrete Mix Design



Determine aggregate proportions and size:

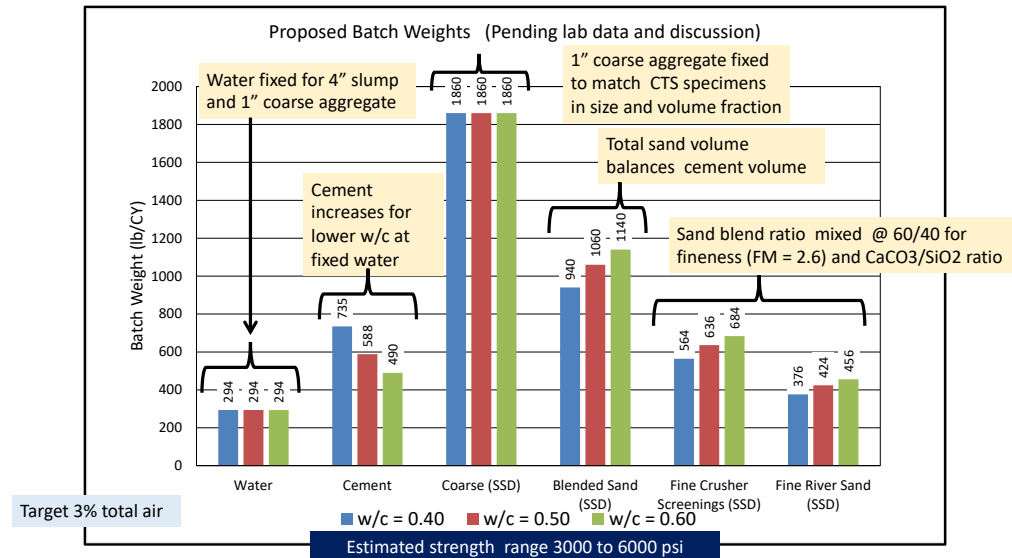
- Air voids, mortar, and aggregate fractions determined by “Point Count.”
- Aggregate size determined by statistics-based visual comparison.



Observations used to determine mixture proportions for trial mixes:

- Coarse aggregate and water fraction held constant for workability.
- Water-to-cement ratio (w/c) varied to control strength.
- Results show that ~ 4000 psi can be achieved at high w/c .
- Implications for structure service life and durability.

PRELIMINARY ANALYSIS RESULTS



CTS Investigation: Invasive Testing

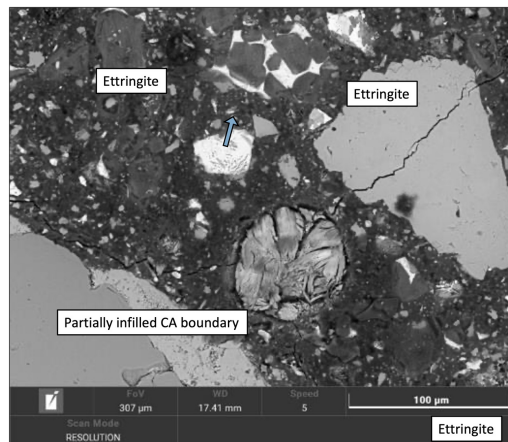
Invasive Testing: Approximately 70 cores obtained (or 18% of the cores required for the invasive testing plan)

- 70% of the cores have been tested for mechanical properties
- 30% of the cores have undergone other materials testing

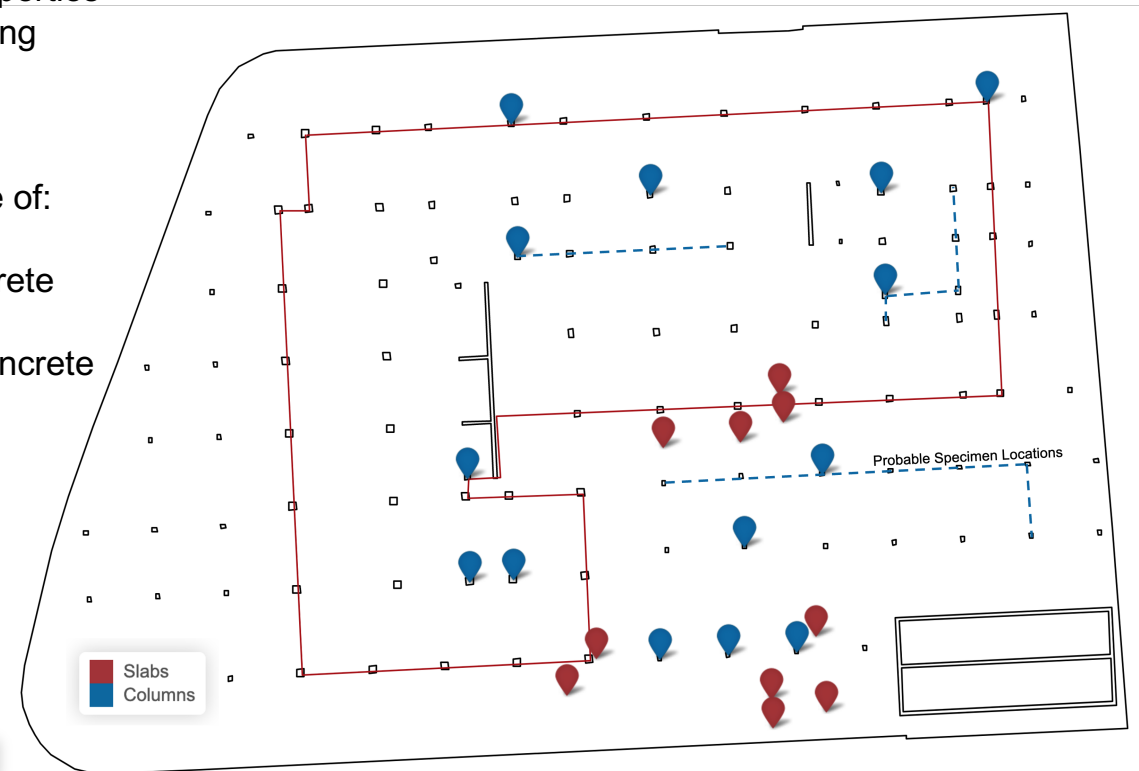
Mechanical Properties: Compression strength and elastic modulus tests are currently underway

Preliminary Petrography: We have observed evidence of:

- Microstructural changes due to environmental factors
- Higher air content and water/cement ratio in slab concrete relative to column concrete
- Lower air content and water/cement ratio in column concrete



Probable locations of specimens subsampled in Phase1



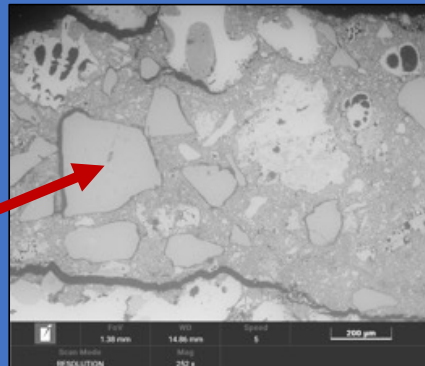
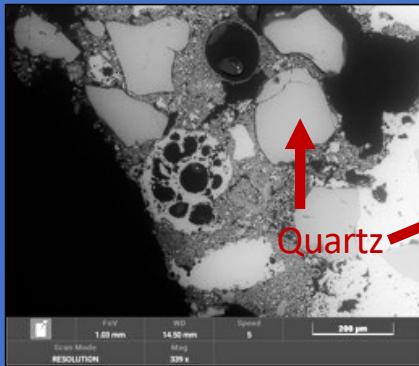
PRELIMINARY ANALYSIS RESULTS

CTS Investigation: Geotechnical Analysis and Testing

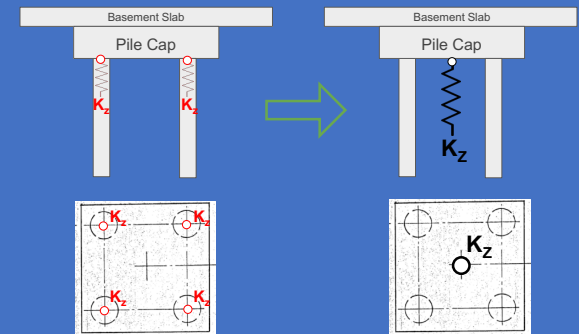
Evaluating the subsurface soils and soil-structure interaction

NIST

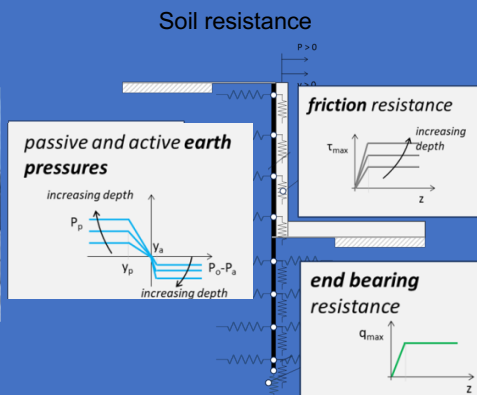
Limestone Laboratory Testing – Scanning Electron Microscope



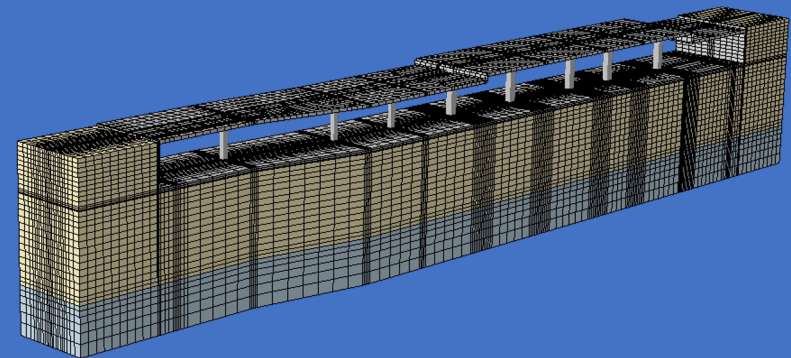
Foundation Compliance – Pile Stiffness – Equivalent Spring Simplified/Preliminary Evaluations



South Wall Lateral Behavior Analyses



Advanced Three-Dimensional Finite Element Soil-Structure Interaction Models



Questions?

Theme 1:

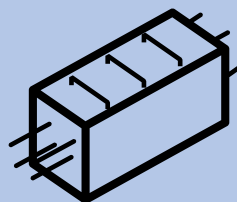
***Evidence Collection,
Measurements, and
Visualization***



*Sissy Nikolaou, Christopher
Segura, Jonathan Weigand, Emel
Ganapati, Georgette Hlepas*

Theme 2:

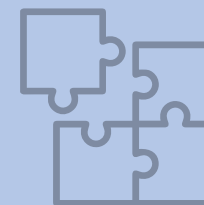
***Materials, Geotechnical,
and Structural
Analysis and Testing***



*Glenn Bell, Ken Hover,
Scott Jones, Youssef Hashash,
Fahim Sadek*

Theme 3:

***Failure Hypotheses
Development
and Evaluation***



*David Goodwin, Kamel Saidi,
Judith Mitrani-Reiser,
Jack Moehle, James Harris*